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ON THE TAXONOMY OF THE *ACANTHOCYCLOPS ROBUSTUS* SPECIES–COMPLEX (COPEPODA, CYCLOPIDAE): *ACANTHOCYCLOPS BREVISPINOSUS* AND *A. EINSLEI* SP. N.

I. M. Mirabdullayev [1], D. Defaye [2]

[1] *Institute of Zoology, Niyazov str., 1, Tashkent, 700095 Uzbekistan*
E-mail: iskandar@mail.tps.uz
[2] *Museum national d'Histoire naturelle, rue de Buffon, 61, Paris, F75005 France*
E-mail: ddefaye@mnhn.fr

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On the Taxonomy of the *Acanthocyclops robustus* Species-Complex (Copepoda, Cyclopidae): *Acanthocyclops brevispinosus* and *A. einslei* sp. n. Mirabdullayev I. M., Defaye D. — New data on morphology of *Acanthocyclops brevispinosus* (Herrick, 1884) are provided. *A. einslei* Mirabdullayev & Defaye, sp. n., previously misidentified as (sensu Petkovski, 1975; Kiefer, 1976; Einsle, 1997 et al.) is described.

Key words: Crustacea, Cyclopidae, new species.

Таксономия комплекса видов *Acanthocyclops robustus* (Copepoda, Cyclopidae): *Acanthocyclops brevispinosus* и *A. einslei* sp. n. Мирабдуллаев И. М., Дефай Д. — Приведены новые сведения по морфологии *Acanthocyclops brevispinosus* (Herrick, 1884). Вид, ранее ошибочно идентифицировавшийся как *A. robustus* (sensu Petkovski, 1975; Kiefer, 1976; Einsle, 1997 и др.), описан в качестве нового вида *A. einslei* Mirabdullayev & Defaye, sp. n. Приведены данные по распространению и изменчивости.

Ключевые слова: Crustacea, Cyclopidae, новый вид.

Introduction

The freshwater cyclopid genus *Acanthocyclops* (Kiefer, 1927) has a world-wide distribution and comprises about fifty species and subspecies. It is important in ecological respect since most of the species inhabit continental waterbodies, as well as being components of the plankton as well as of the benthon and in some cases subterranean biotopes. The genus has been the subject of numerous papers, especially concerning two widespread species, *Acanthocyclops vernalis* (Fischer, 1853) and *Acanthocyclops robustus* (G. O. Sars, 1863). Their identification long remained problematic and has been largely discussed during the last decades because of ecological variability of the morphological characters used for their identification.

The importance of the variability of these two «phenotypically plastic» species, in terms of size, furcal index, relative length of furcal setae, ornamentation of setae and spines of the natatory legs, and even spine formula has been recorded by different authors, both in field and laboratory studies (Kiefer, 1976; Dodson, 1994; Einsle, 1993; Lescher-Moutoué, 1996). V. Einsle (1992, 1996) pointed out the need to take into account all these morphological characters with critical attention, as well as the usefulness of other characters, such as the number of chromosomes.

After re-examining a number of specimens identified as *A. robustus*, we came to the conclusion that it was also necessary to re-examine specimens of the taxa considered as its synonyms: *A. robustus* f. *limnetica* Petkovski, 1975 and *A. americanus* (Marsh, 1873) (Kiefer 1978; Dussart, Defaye, 1985). *A. brevispinosus* (Herrick, 1894) has been recognised by Dodson (1994) as a valid species and carefully redescribed by Dahms, Fernando (1997) and should no longer be considered as a synonym of *A. robustus* or *A. vernalis*. Although it has a laterally rounded genital segment, it differs from *A. robustus* by several characters, particularly the setation pattern of the proctodeum and the spatulate spines on P3 and P4. *A. americanus* have been generally identified considering specimens of *robustus*-like *Acanthocyclops* showing a rounded genital segment and characteristics of the furca and the endopodite of P4 (Lowndes, 1926; Gurney, 1933; Рылов, 1948; Dussart, 1969; Monchenko, 1974; Alekseev, Kosova, 1976; Alekseev, 1995 etc.).

F. Kiefer (1976), in comparing specimens of *A. robustus* from G. O. Sars's collection with those identified by C. D. Marsh as *A. americanus* concluded that these forms were conspecific. He established then

also that, in fact, there were two different species (both determined as *A. americanus*) in Marsh' s collection, one with rounded genital segment (*robustus*-like) and other with laterally angled genital segment (*vernalis*-like). Kiefer's synonymy of *A. americanus* Marsh with *A. robustus* Sars has been accepted by most copepodologists (Petkovski, 1975; Fryer, 1985; Defaye, Dussart, 1985; Kawabata, Defaye, 1994; Dodson, 1994; Einsle, 1996; Dahms, Fernando, 1997).

Studying *Acanthocyclops robustus* from waterbodies of Yugoslavia, T. Petkovski (1975) described a new form — *A. robustus* f. *limnetica*. He thought that this form differed only slightly from the typical form, mostly by characters of Enp3P4: the ratio between the length of inner apical spine of Enp3P4 and the width of Enp3P4 which is over 2.00 (2.10–2.40), compared with only 1.40–1.60 for the typical form. Enp3P4 of the limnetic form is also thinner, with L: W over 2.30 (2.31–2.40), whereas in the typical form, it is significantly lower (1.95–2.30) (Petkovski, 1975).

In studying specimens identified as *A. robustus* from waterbodies of Europe, Asia, America and North Africa, we also could distinguish two forms, corresponding to Petkovski's forms. Detailed study has revealed additional characters which allow the unambiguous separation of these forms and support their separation as valid species. The comparison of these species with specimens from G. O. Sars's collection have unexpectedly revealed differences, which require a revision of the whole group.

In previous paper (Mirabdullayev, Defaye, 2002) we redescribed *Acanthocyclops robustus* (Sars, 1863). In this article we describe *Acanthocyclops einslei* sp. n. Additional data are provided concerning morphology and variability of *A. brevispinosus* (Herrick, 1894).

Abbreviations: Me — lateral furcal seta; Ti — innermost apical furcal seta; Tmi — inner medial apical furcal seta; Tme — outer medial apical furcal seta; Te — outermost apical furcal seta; Sd — dorsal furcal seta.

Acanthocyclops brevispinosus (Herrick, 1884) (fig. 1–2)

Cyclops brevispinosus Herrick, 1884. *Acanthocyclops brevispinosus* (Herrick, 1884): Einsle, 1992, part., Figs. 9Z, 12; Dodson, 1994; Dahms, Fernando, 1997.

Material examined. USA: 3 ♀, Lake Erie, N. Y., 12.07.1928, USNM 62594, C. Marsh Collection; ♀, Wisconsin, Mirror Lake, 10.06.1989, USNM 259375, S. Dodson Coll.; Detroit River, 20.04.1988, U. Einsle Coll. 3785–3787; ♀, Indiana, Lake Maxinkuckee, Kiefer Coll. 10518. Canada: 2 ♀, Lake Pinehurst, Ontario, 22.06.1992 (leg. H.-U. Dahms); 3 ♀, Columbia Reservoir, Ontario, 18.05.1992 (leg. H.-U. Dahms).

Acanthocyclops brevispinosus has been redescribed in detail by Dahms and Fernando (1997). However, the ornamentation of caudal side of the basipodite of antenna was not figured by these authors (fig. 1–2).

Some additional characters can be noted: aesthetasc on 12th segment of antennule not reaching distal margin of 14th segment; inner distal claw-like seta of basipodite of maxilla smooth; length ratio of the two shortest apical setae of Enp2 of maxilliped = 1.55–1.80; intercoxal plates of P1–P3 without ornamentation; Enp3P4 2.2–2.5 times as long as wide, inner apical spine 0.75–0.95 times as long as segment and usually slightly shorter than outer spine, outer lateral spine (very rarely a seta) situated at 0.70–0.80 of the segment length; spine formula of the exopodites of P1 to P4: 3.4. 4.4 (no variability observed). Furcal setae: Ti very short, 0.4–0.5 times as long as furca. Ti/Tmi = 0.12–0.16; Ti/Tme = 0.19–0.21; Ti/Te = 0.95–1.30; Ti/Sd = 0.80–1.05.

Differential diagnosis. *Acanthocyclops brevispinosus* differs from *A. robustus* and *A. petkovskii* Pesce et Lattinger mainly by the pattern of setation of the proctodeum which is a patchy symmetrical field of spinules, by the ornamentation of the antennary

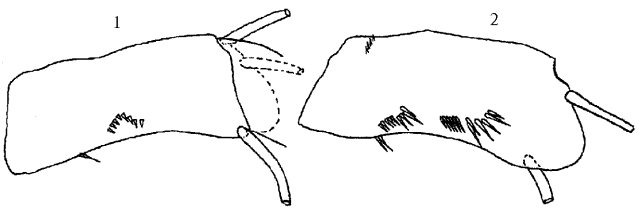

Fig. 1–2. *Acanthocyclops brevispinosus*, ♀ (Canada, Ontario, Lake Pinehurst): 1 — basipodite of antenna, caudal side; 2 — basipodite of antenna, frontal side. Scale bar 50 mkm.

Рис. 1–2. *Acanthocyclops brevispinosus*, ♀ (Канада, Онтарио, оз. Пайнхурст): 1 — базоподит антенны, каудальная сторона; 2 — базоподит антенны, фронтальная сторона. Масштабная линейка 50 мкм.

basipodite and by the level of insertion of the outer lateral spine of Enp3P4. It also differs from both species by the length of the aesthetasc on 12th segment of antennule relative to the distal margin of 14th segment. It further differs from *A. robustus*, by the length ratio of the apicalmost setae of the maxilliped (higher in *A. brevispinosus)*, and from *A. petkovskii* by the ornamentation of the claw-like seta of basipodite of maxilla (absent in *A. brevispinosus)*. Moreover, *A. brevispinosus* is easily recognisable by the shape of the lanceolate enlarged spines on P3 and P4, not previously observed in other taxa of the *robustus* species-complex.

Distribution. *Acanthocyclops brevispinosus* inhabits waterbodies of Canada and USA.

Ecology. Poorly known. Plankton of lakes and ponds (Dodson, 1994).

Acanthocyclop einslei Mirabdullayev & Defaye, **sp. n.** (fig. 3–24)

Acanthocyclops robustus (G. O. Sars, 1863), Kiefer (1933); Dussart et al. (1966), part., Figs. 9, 12, 14; Dussart (1969); Einsle (1996), part., Fig. 53 DR; Petkovski (1975), typical form; Kawabata, Defaye, 1994; Alekseev et al., 2002. *Acanthocyclops robustus* f. *typica*: Mirabdullayev, Dahms, 1999. *Acanthocyclops americanus* (Marsh, 1893), Dussart (1970).

Material examined. France: 4 ♀, Lake Creteil, near Paris, Nov. 1969, MNHN–Cp800. Belgium: ♀, pond in Ghent, July 1999 (leg. V. Alekseev). Hungary: ♀, fishpond, 29.05.1992 (leg. M. Holynska). Germany: many females and males, Oldenburg, Wechloy, ditch near University; July 1998. Italia: ♀, Trasimeno, Kiefer's coll. 7830, ♀; 10233. Yugoslavia: 10 ♂, 8 ♀, Montenegro (leg. T. Karanovic). Uzbekistan: many specimens from 7 localities in the Tashkent and Samarkand provinces, coll. I. M. Mirabdullayev. Kazakhstan: 4 ♀, fishpond, Chilik Fishery Farm, Kazakhstan (leg. T. S. Stuge). Japan: ♂, ♀, Kahoko, 29.07.1993

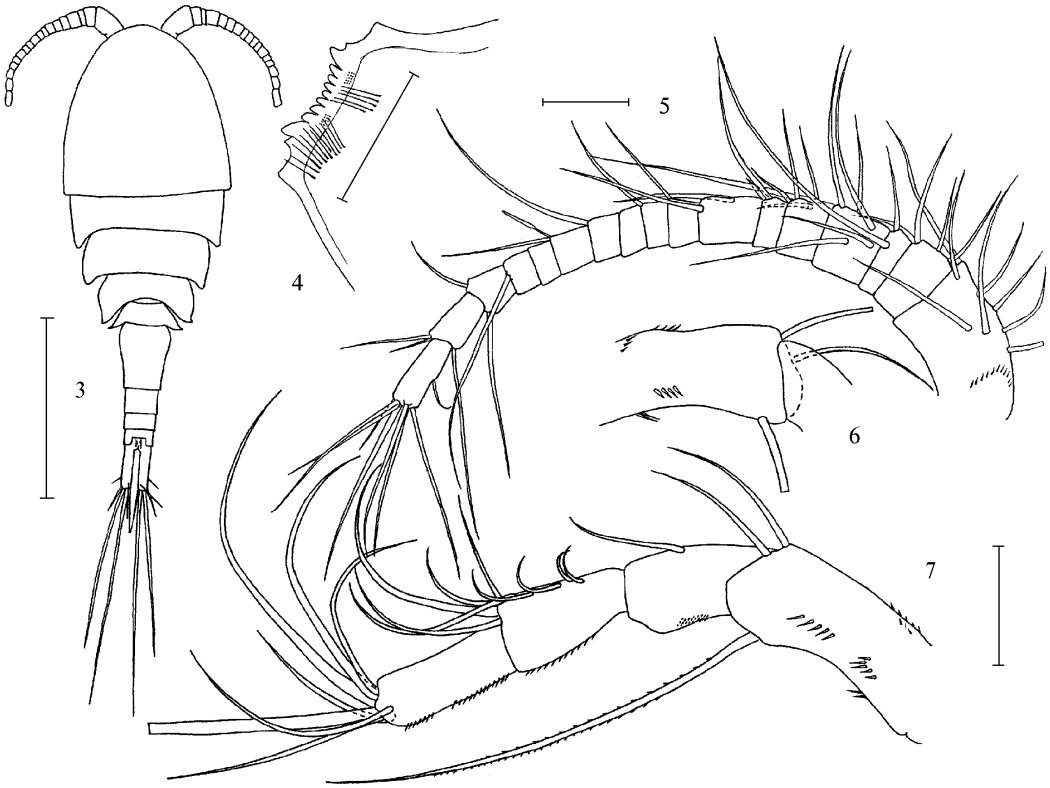

Fig. 3–7. *Acanthocyclops einslei*, holotype, ♀ (Germany): 3 — habitus; 4 — labrum; 5 — antennule; 6 — antenna, caudal side; 7 — basipodite of antenna, frontal side. Scale bar 50 mkm except 3 : 500 mkm).

Рис. 3–7. *Acanthocyclops einslei*, holotype, ♀ (Германия): 3 — габитус; 4 — лабрум; 5 — антеннула; 6 — антенна, каудальная сторона; 7 — базоподит антенны, фронтальная сторона. Масштабная линейка 50 мкм, исключая 3 : 500 мкм.

(leg. Kawabata). USA: 4 ♀, Lake Erie, N. Y., 12.07.1928. USNM 62594, Marsh Coll. Canada: many specimens, Waterloo, Ontario, 22.06.1992 (leg. H.-U. Dahms). Indonesia: ♀, Sumatra. Kiefer's coll. 1685–1686.

Holotype. A dissected female, from ditch in Wechloy, Oldenburg, Germany, July 1998 mounted on slide and deposited in the Museum National d'Histoire Naturelle, Paris (France) (MNHN-Cp1873)

Paratypes: 3 dissected females from the same locality as holotype, mounted on slides, MNHN-Cp1874 to MNHN–Cp1876; 2 dissected females, from the same locality as the holotype, mounted on slides and deposited at the Institute of Zoology, Tashkent, Cp111); 2 dissected females, mounted on slide (Zoologish Museum, Amsterdam); 10 ♀ and 3 ♂, ethanol preserved and deposited as the holotype (MNHN–Cp1877); 10 ♀ and 3 ♂, ethanol preserved, deposited at the Institute of Zoology, Tashkent (De–P1/6).

Female. The description and figures are of the female holotype, except that figure 6 is of a paratype.

Body length (furcal setae excluded): 1300 mkm.

Antennule short, not reaching the distal margin of the first thoracic somite (fig. 3), 17-segmented, with armature as follows: 8, 4, 2, 6, 4, 1 + spine, 2, 1, 1, 0, 1, 1 + aesthetasc, 0, 1, 2, 2 + aesthetasc, 7 + aesthetasc. Aesthetasc on 12th segment of antennule reaching distal margin of 14th segment. First segment bearing a row of spinules (fig. 5).

Antenna. Ornamentation of basipodite as in figures 6–7, resembling that of *A. brevispinosus*; spinules of longitudinal row thin and oriented at sharp angle to axis of basipodite (fig. 6–7). Third segment of antenna bearing 9 setae.

Labrum with 12–13 teeth (fig. 4).

Mandible and maxillule as on figures 8–10.

Maxilla: general shape as in *A. robustus*. Inner claw-like seta of basipodite smooth or bearing a few spinules, sometimes a row of spinules present on outer side, but never with a row of spinules on inner side (fig. 11).

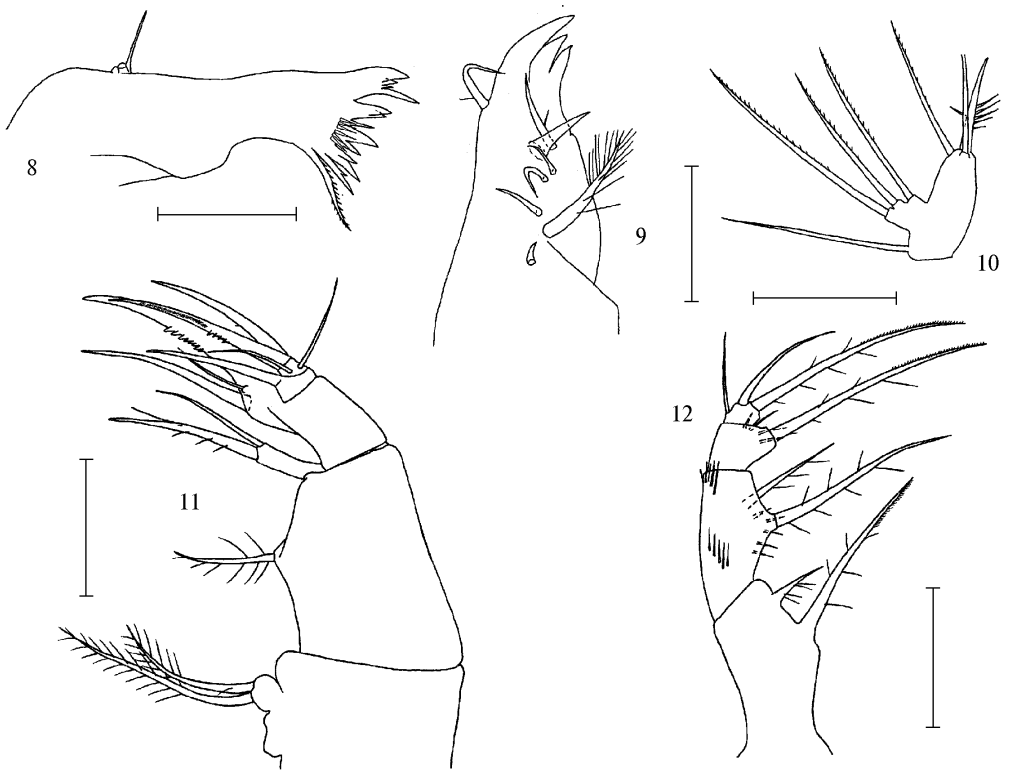

Fig. 8–12. *Acanthocyclops einslei*, holotype, ♀ (Germany. MNHN–Cp800): 8 — mandible; 9 — maxillule; 10 — palp of maxillule; 11 — maxilla; 12 — maxilliped. Scale bar 50 mkm.

Рис. 8–12. *Acanthocyclops einslei*, голотип, ♀ (Германия. MNHN–Cp800): 8 — мандибула; 9 — максиллула; 10 — щупик максиллулы; 11 — максилла; 12 — максиллипеда. Масштабная линейка 50 мкм.

Maxilliped. General shape as in *A. robustus*. Length ratio of two apicalmost spines: 1.4 (fig. 12).

Natatory legs (fig. 13–16): spine formula of P1–P4 : 3.4–4.4 (usual formula). General armature as follows:

	Coxopodite	Basipodite	Endopodite	Exopoditeiteite
P1	0–1	1–1	0–1; 0–2; 1, I, 4	I-1; I-1; III, [1], 3
P2	0–1	1–0	0–1; 0–2; I, I-1,3	I-1; I-1; III, I–1,3
P3	0–1	1–0	0–1; 0–2; I, II, 3	I-1; I-1; III, I, 4
P4	0–1	1–0	0–1; 0–2; I, II, 2	I-1; I-1; III, I–[1], 3

Intercoxal plates of P1–P3 without ornamentation, intercoxal plate of P4 with row of spinules on caudal side. Coxopodite of P1–P3 with group of 4–5 long spinules on caudal side. Coxopodite of P4 with rows of shorter spinules near distal and proximal

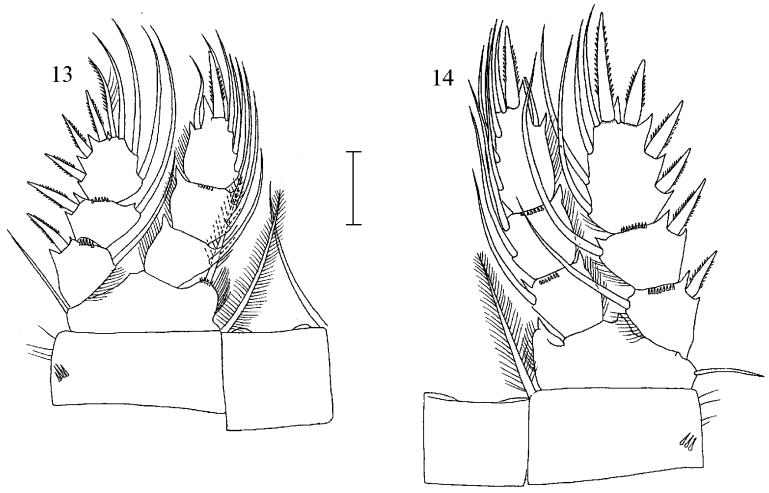

Fig. 13–14. *Acanthocyclops einslei*, holotype, ♀ (Germany. MNHN–Cp800): 13 — P1; 14 — P2. Scale bar 100 mkm.

Рис. 13–14. *Acanthocyclops einslei*, голотип, ♀ (Германия. MNHN–Cp800): 13 — P1; 14 — P2. Масштабная линейка 100 мкм.

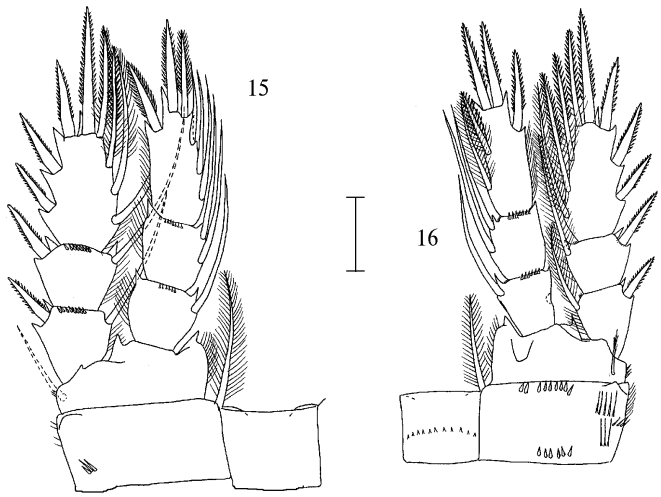

Fig. 15–16. *Acanthocyclops einslei*, holotype, ♀ (Germany. MNHN–Cp800): 15 — P3; 16 — P4. Scale bar 100 mkm.

Рис. 15–16. *Acanthocyclops einslei*, holotype, ♀ (Германия. MNHN–Cp800): 15 — P3; 16 — P4. Масштабная линейка 100 мкм.

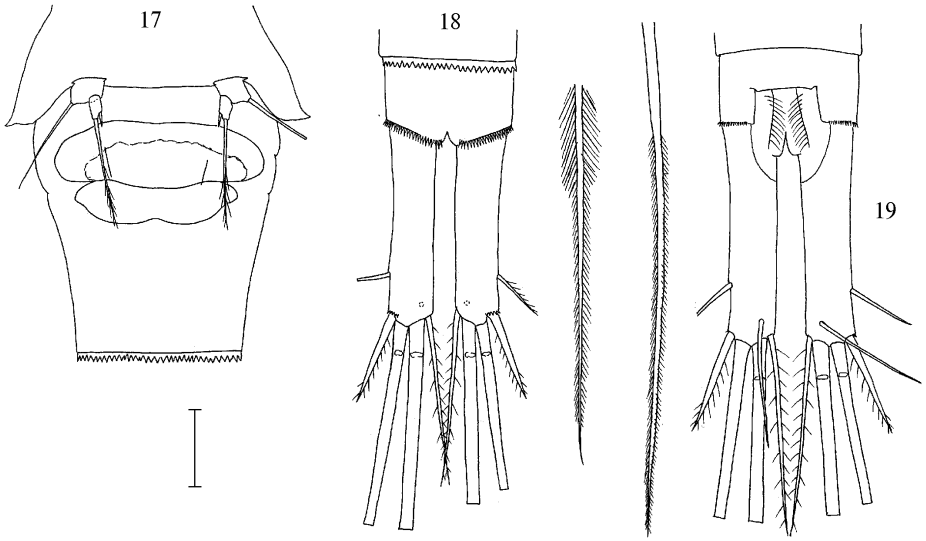

Fig. 17–19. *Acanthocyclops einslei*, holotype, ♀ (Germany. MNHN–Cp800): 17 — last thoracic and genital somites; 18 — furca, ventral side; 19 — furca, dorsal side. Scale bar 100 mkm.

Рис. 17–19. *Acanthocyclops einslei*, голотип, ♀ (Германия. MNHN–Cp800): 17 — последний торакальный и генитальный сегменты; 18 — фурка, вентрально; 19 — фурка, дорсально. Масштабная линейка 100 мкм.

margins and 2 rows of longer and thinner spinules near lateral margin. Inner edge of basipodite P1–P4 with setules. Apical inner edge of basipodite P1 with a long spine, not reaching half the length of Enp3. Enp1P4 with a developed notch on the outer margin. Enp3P4 2.4 times as long as wide. Inner apical spine 0.77 times as long as segment and 1.03 times as long as outer spine. Outer lateral spine situated at 0.77 of the segment length.

P5 consisting of 2 segments. Basal segment with long outer seta. Free segment with long apical seta and short inner subapical spine (fig. 17).

Genital segment broadly rounded in its anterior part (fig. 17). Seminal receptacle similar to that of *A. robustus*, with notched anterior margin, but anterior and posterior parts more rounded.

Anal segment with spinules (larger on ventral side) on its distal margin. Proctodeum with a single row of setules on either side (fig. 19).

Furcal rami parallel, 4.5 times as long as wide, without hairs on inner margin but usually covered by tiny spinules. Implantation of Te provided with spinules. Implantation of Me without spinules (fig. 18–19). Tme bearing short setules along distal half of its length. Ti bearing long setules on most of its length and shorter setules on its last quarter. Ti 0.90 times as long as furcal rami. Ti/Tmi = 0.20; Ti/Tme = 0.31; Ti/Te = 1.8; Ti/Sd = 1.6.

Male. Length (furcal setae excluded): 850–1250 mkm (n = 11).

Antennule with three aesthetascs on segment 1, one aesthetasc on segment 4, and one aesthetasc on segment 8 (fig. 20).

Antenna with third segment bearing 8 setae (fig. 21).

P1–P5 segmentation and armature identical to those of female. Apical spines of Enp3P4 relatively longer than in female (fig. 22). P6 with inner spine longer than the middle seta and shorter than outer seta (fig. 23).

Furcal rami relatively shorter than in female, 3.8–5.7 times as long as wide. Implantation of Me and Te provided with spinules (fig. 24).

Variability. Measurements of specimens from different populations are given in table 1.

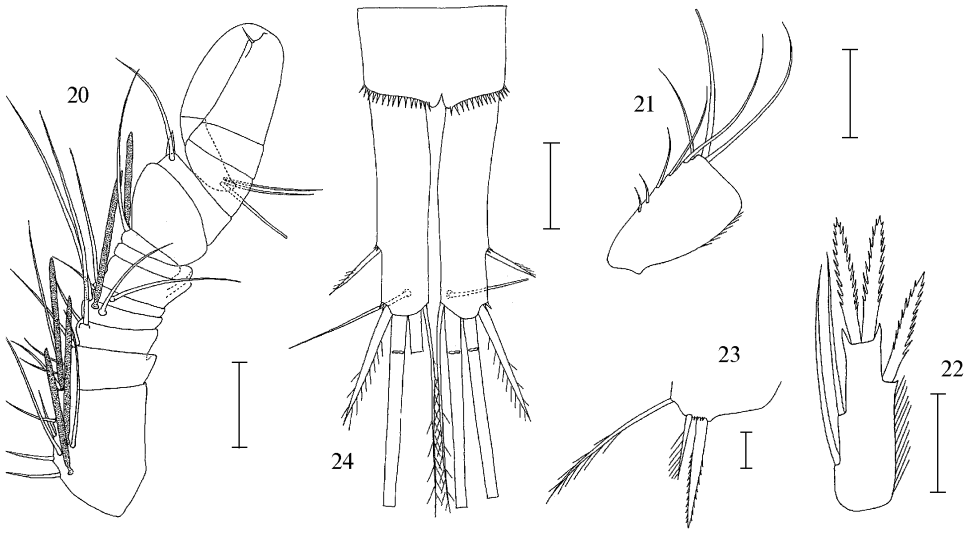

Fig. 20–24. *Acanthocyclops einslei*, allotype, ♂ (Germany. MNHN–Cp800): 20 — antennule; 21 — third segment of antenna; 22 — Enp3P4; 23 — P6; 24 — furca. Scale bar 50 mkm except 23 — 10 mkm.

Рис. 20–24. *Acanthocyclops einslei*, аллотип, ♂ (Германия. MNHN–Cp800): 20 — антеннула; 21 — третий членик антенны; 22 — эндоподит P4; 23 — P6; 24 — фурка. Масштабная линейка 50 мкм, исключая 23 — 10 мкм.

Body length. 1200–1800 mkm (n = 67). Length ratio of two apicalmost spines of maxilliped 1.3–1.8. Enp3P4 L/W = 2.0–2.7. Inner apical spine 0.6–0.8 times as long as segment and usually 1.00–1.05 times as long as outer spine. Outer lateral spine (sometimes a seta) situated at 0.70–0.80 of the segment length. Furcal rami 4.2–6.4 times as long as wide. Ti 0.75–0.95 times as long as furcal rami. Ti/Tmi = 0.18–0.25; Ti/Tme = 0.28–0.35; Ti/Te = 1.5–2.0; Ti/Sd = 1.5–1.9. Apical furcal setae (Tmi and Tme) can bear long setules along most of their length or short setules on only distal half. Enp3P4 usually bears 3 spines.

Differential diagnosis. *Acanthocyclops einslei* sp. n. differs from most species of the *Acanthocyclops vernalis-robustus* species-complex, including from the species described above, by the shape of Enp3P4, and the complete absence of ornamentation on intercoxal plates of P1. *Acanthocyclops einslei* sp. n. differs from the closest species, *A. brevispinosus* by the pattern of ornamentation of the proctodeum, the relatively shorter apical spines of Enp3P4 and the relatively longer inner apical furcal seta. It differs from *A. trajani* sp. n. by the absence of spinules on inner side of the claw-like seta of the basipodite of the maxilla, the length ratio of the apicalmost setae of the maxilliped and the length ratio Ti/Tmi and Ti/Tme. It differs from *A. robustus* by the absence of spinules near the exopodite-seta of basipodite of antenna and by the relatively shorter Ti.

Distribution. *Acanthocyclops einslei* sp. n. inhabits waterbodies of Eurasia (not recorded in Scandinavia) and North America.

Ecology. *Acanthocyclops einslei* sp. n. prefers polluted pools, ditches and small ponds poor in phytoplankton. It can also be found in the littoral zone of lakes. In North America, it sometimes co-occurs with *A. robustus*. In France (pond in vicinity of Paris) and in Kazakhstan (fishpond), the species was co-occurred with *Acanthocyclops trajani*.

Etymology. Named in honour of the late Dr U. Einsle for his contributions to our knowledge of *Acanthocyclops* systematics.

Table 1. Measurements of *Acanthocyclops einslei* (adult females)*
Таблица 1. Размеры *Acanthocyclops einslei* (взрослые самки)

Measurement	Germany, Oldenburg, Wechloy x min–max	Yugoslavia, Montenegro x min–max	Uzbekistan, Khalkabad, pond x min–max	Canada, Waterloo, Ontario x min–max	France, Creteil, x min–max
Body length, mkm	1282 1200–1400	1196 1165–1275	1683 1500–1850	1180 1125–1200	1800 1800–1800
Fu L/W	4.94 4.45–5.50	4.40 4.15–4.55	5.62 5.00–6.40	4.73 4.25–5.20	5.60 5.25–6.20
Ti/Fu L	0.81 0.74–0.90	0.86 0.80–0.90	0.77 0.73–0.82	0.82 0.72–0.90	0.76 0.75–0.76
Ti/Tmi	0.19 0.18–0.19 0	19 0.18–0.21	0.21 0.20–0.23	21 0.21–0.23	0.21 0.19–0.22
Ti/Tme	0.30 0.28–0.33	0.30 0.28–0.33	0.30 0.28–0.32	0.31 0.28–0.34	0.29 0.28–0.29
S1/Te	1.77 1.64–1.87	1.77 1.65–1.95	1.65 1.57–1.76	1.80 1.56–2.09	1.48 1.46–1.50
Ti/Sd	1.75 1.61–1.87	1.79 1.65–2.04	1.74 1.63–1.87	1.81 1.62–2.05	1.78 1.78–1.78
Mxp ap. set. ratio	1.51 1.40–1.60	1.48 1.20–1.65	1.52 1.31–1.62	1.39 1.30–1.71	1.46 1.33–1.65
Enp3P4:					
L/W	2.43 2.30–2.60	2.16 2.05–2.25	2.16 2.00–2.50	2.41 2.13–2.60	2.26 2.14–2.42
Inn. sp./L	0.75 0.65–0.80	0.74 0.69–0.79	0.75 0.70–0.82	0.71 0.66–0.80	0.71 0.62–0.76
Inn. sp./W	1.80 1.69–1.92	1.62 1.53–1.77	1.62 1.40–1.72	1.70 1.58–1.83	1.61 1.44–1.74
Inn. sp./outer sp.	1.05 1.00–1.15	1.00 0.98–1.05	1.04 0.97–1.10	1.03 0.98–1.05	1.04 1.00–1.10
Lat. set. position	0.80 0.75–0.82	0.78 0.75–0.80	0.75 0.73–0.77	0.78 0.76–0.83	0.77 0.76–0.78

* n = 10 except France n = 4.

Discussion

The species described above appear to be very close, but by using additional characters shown to be constant in the female (length ratio of the apicalmost setae of the endopodite of the maxilliped, ornamentation of the claw-like seta of basipodite of maxilla, level of insertion of the outer seta/spine of Enp3P4), in combination with the other characters previoulsy used, it is possible to characterize each taxon.

T. Petkovski (1975) already had enough data to distinguish *A. trajani* as a separate species. Dussart (1967) also saw clear differences in shape of Enp3P4 of specimens from France. However, B. Dussart (pers. comm.) also discussed this problem with F. Kiefer. The latter examined large number of specimens from many geographic origins, but could not diagnose a separate species on the basis of the characters he studied, particularly in view of the variability of Enp3P4 and the overlapping of indices (Enp3P4 Int. sp./L; Int. sp./W) (Kiefer, 1976). The present study of microcharacters, added to the morphological measurements (table 2), has allowed us to separate the different taxa and define the two new species, *A. trajani* sp. n. and *A. einslei* sp. n.

A. trajani sp. n. corresponds to *A. americanus* sensu Lowndes (1926), Rylov (1948), V. I. Monchenko (1961, 1974), B. Dussart (1969) and V. R. Alekseev (1995). Marsh's types of *A. americanus* from Wisconsin appear to be lost. Prof. F. Kiefer studied 3 samples from the US National Museum from other localities (Kansas, Alaska), determined by Marsh as *A. americanus*. F. Kiefer (1976) recognised 2 different species

Table. 2. Comparison of biometrics of species of the *Acantocyclops robustus* species-complex
Таблица 2. Сравнение биометрических показателей видов комплекса *Acantocyclops robustus*

Biometric	*A. robustus*	*A. trajani*	*A. einslei*	*A. brevispinosus*
Body length, mkm	1025–1215	1025–1600	165–1800	1200–1230
Fu L/W	4.00–5.45	4.15–5.80	4.15–6.40	5.20–6.85
S1/ Fu	0.55–0.79	0.81–1.04	0.73–0.94	0.39–0.48
S1/s2	0.15–0.19	0.23–0.29	0.18–0.25	0.12–0.16
S1/s3	0.26–0.32	0.34–0.42	0.28–0.35	0.18–0.21
S1/s4	1.24–1.68	1.45–2.20	1.46–2.00	0.94–1.32
S1/s5	1.20–1.50	1.45–1.80	1.48–1.95	0.80–1.05
Mxp ap. set. ratio	1.18–1.33	1.70–2.25	1.20–1.80	1.55–1.80
Enp3P4:				
L/W	2.05–2.67	2.25–3.10	2.00–2.60	2.20–2.50
Inn. sp. /L	0.71–0.93	0.77–0.96	0.62–0.82	0.76–0.95
Inn. sp. /W	1.71–2.15	1.87–2.46	1.45–1.90	1.75–2.25
Inn. sp./out. sp.	0.99–1.13	1.04–1.29	0.97–1.15	0.90–1.00
Lat. set. position	0.62–0.71	0.55–0.66	0.69–0.82	0.71–0.80

in these samples which he identified as *A. robustus* and *A. vernalis*. F. Kiefer therefore rejected the name "*americanus*", synonymising it partly with *A. robustus*, and partly with *A. vernalis*. We also checked three samples originally identified by Marsh as *A. americanus* from the same museum in Washington, all labelled as *A. robustus*. We have found 4 different species in these samples that we identified as *A. trajani* sp. n., *A. einslei* sp. n., *A. brevispinosus* and *A. vernalis*. *Acanthocyclops. trajani* sp. n. had been determined by Marsh as "*americanus*".

The original description of *A. americanus* is very succinct according to the standards of modern taxonomy. From Marsh's (1893) figures, (Plate IV, fig. 8–10), P4 can be supposed to be that of *A. vernalis* (inner apical spine is shorter than outer and is only about 1.20 of width and 0.55 of length of Enp3P4). The genital segment, however, is shown with rounded lateral sides, but as F. Kiefer (1976) suggested, it is possible that this is an artefact caused by flattening of the specimen by the cover glass. Consequently, it is possible that the first description of *A. americanus* by Marsh corresponds to *A. vernalis*.

We consider the four species studied here as belonging to the *Acanthocyclops robustus* species-complex. Females share the common characters of the segmentation and armature of the antennule; the general pattern of the ornamentation of basipodite of the antenna (two small separate rows of spinules on caudal side, one basolateral on frontal side) and the number of setae on the third segment of antenna; the general pattern of the other buccal appendages; the general segmentation of natatory legs and P5; the shape of the genital double somite. Males share the segmentation and armature of the antennule, the armature of furca including the spinules at the implantation of Me and Te.

The main traits separating the species are as follows:

Acanthocyclops robustus is the only species of this group to possess a group of spinules on the apical inner margin of the basipodite of the antenna. *A. trajani* sp. n. and *A. einslei* sp. n. are the only species possessing denticulation on the claw-like seta of the basipodite of maxilla, *A. trajani* always on both sides and *A. einslei* never on the inner side, but they differ, for example, by the site of insertion of the outer seta/spine on Enp3P4. *Acanthocyclops brevispinosus* differs from its congeners by the patchy pattern of setation of the proctodeum and by the absence of ornamentation on the intercoxal plates of P1 to P3. It also differs from its closest relative — *A. einslei* by the shorter Ti, the longer apical spines of Enp3P4 and the shorter setae of Enp3P4. *A. trajani* also differs from all species mentioned, by the ornamentation of the antenna, the length ratio of the two api-

calmost setae of maxilliped, the armament of inner claw-like spine of the basipodite of maxilla, and often by the presence of ornamentation on intercoxal plates of P2 and P3.

The validity of these species is strongly supported by the set of morphological characters used in this study, but complementary studies, as cytogenetics (in preparation) should be useful in testing this approach to the taxonomy of species-complexes.

Key to species of the *Acanthocyclops robustus* species-complex (females)
Таблица для определения комплекса видов *Acanthocyclops robustus* (самки)

1. Basipodite of antenna with spinules near exopodite-seta. ..... *A. robustus* (G. O. Sars, 1863)
— Basipodite of antenna without spinules near exopodite-seta. 2
2. Implantation of lateral seta/spina of Enp3P4 at 0.55—0.65 of length of the segment. ..... *A. trajani* sp. n.
— Implantation of lateral seta/spina of Enp3P4 at 0.70—0.80 of length of the segment. 3
3. Setules near anal opening in 2 patches; Ti shorter than 1/2 length of furca, no spinules on the furcal rami. ..... *A. brevispinosus* (Herrick, 1884)
— Setules near anal opening in 2 rows; Ti longer than 3/4 length of furca, tiny spinules on the furcal rami. ..... *A. einslei* sp. n.

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